Assessing Impulsivity in Chinese: Elaborating Validity of BIS among Male Prisoners

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Abstract: This study was carried out to test the factor structure and psychometric properties of the Barratt Impulsiveness Scale version 11 (BIS-11), and its short versions (the 8-item and 15-item BIS) in a sample of 424 Chinese male prisoners (M = 31.26, SD = 7.43, aged from 18 to 52 years). Confirmatory factor analysis (CFAs) indicated that the single-factor model of BIS with 8 items (BIS-8) and the three-factor model of BIS with 15 items (BIS-15) fit the data well. Additionally, the item response theory (IRT) approach confirmed the construct and items for the BIS-8 with good discrimination, threshold parameters, and test information curve. Correlations with psychopathic traits, antisocial personality disorder, and aggression suggested that the performance of the 8-item BIS was comparable to that of the original 30-item BIS scale in measuring general impulsivity.

Keywords: impulsivity; BIS; Chinese; male prisoner; short form

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Impulsivity is defined as a tendency to act without considering the negative consequences of one's actions to one's self or to others (Moeller, 2009). It has been of great interest to researchers in personality and clinical psychology due to its relevance to a wide range of psychiatric disorders (e.g., conduct problems, Nigg, 2003; antisocial personality disorders [ASPD], Fossati et al., 2004; Swann, Lijffijt, Lane, Steinberg, & Moeller, 2009). Consistent evidence has shown that impulsivity is positively correlated to psychopathic traits (e.g., Hare, 2003) and aggression (e.g., Barratt & Slaughter, 1998; McMurran, Blair, & Egan, 2002). Higher impulsivity is also associated with a higher rate of recidivism and criminal behavior (e.g., Gordon & Egan, 2011).

Although early views relied on biological aspects and focused on the state of impulsivity (e.g., Apter et al., 1990), researchers increasingly agree that impulsivity is a stable personality trait (DeYoung, 2010; Sharma, Kohl, Morgan, & Clark, 2013). Early personality theorists viewed impulsivity as a unidimensional construct (e.g., Guilford & Zimmerman, 1949) and placed impulsivity within a broader personality dimension. For example, impulsivity and sociability were combined into the Extraversion scale of the Eysenck Personality Inventory (EPI; Eysenck & Eysenck, 1968). Although impulsivity is considered an important aspect of many psychological disorders (e.g, attention-deficit/hyperactivity disorder; antisocial and borderline personality disorders) and serves as the centerpiece in several etiological theories of crime (e.g., Lynam & Miller, 2004), there is a lack of consensus regarding the structure of impulsivity.

A number of self-report instruments of impulsivity have been developed (e.g., Patton, Stanford, & Barratt, 1995; Whiteside, Lynam, Miller, & Reynolds, 2005), and most of these usually adopt a multidimensional views (e.g., Barratt Impulsiveness scale, Version 11; Patton et al., 1995; UPPS Impulsive Behavior Scale; Whiteside & Lynam, 2001; Whiteside et al, 2005). Among those, the Barratt Impulsiveness Scale, version 11 (BIS-11; Patton et al., 1995), is regarded as the gold-standard measure (Stanford et al., 2009). Up to now (May 2017), there have been more than 4400 citations of the BIS (Patton et al., 1995), according to Google Scholar. The BIS has also been translated and psychometrically validated across different languages, such as Chinese (Yao et al., 2007), Japanese (Someya et al., 2001), German (Hartmann, Rief, & Hilbert, 2011), and Italian (Fossati, Di Ceglie, Acquarini, & Barratt, 2001). The BIS has been influential in shaping current theories of impulse control (Reise, Moore, Sabb, Brown, & London, 2013) and conceptualizations of impulsivity in personality and clinical literature (see Stanford et al., 2009, for a review).

The BIS was originally developed by Barratt (Barratt, 1959) to achieve two goals: (1) to assess impulsivity and anxiety as orthogonal constructs; and (2) to define impulsiveness within the structure of related personality traits, such as sensation seeking. Based on Hull/Spence's learning theory (Hull, 1943; Spence, 1956), Taylor (1958) proposed that anxiety was related to "habit strength" and impulsiveness was related to the construct of "behavioral oscillation". Barratt (1994) posited that "habit strength" and "behavioral oscillation" were related to different neural systems.

The BIS has since been revised to better reflect Barratt's theory of multidimensional impulsiveness. The most recent version, BIS-11, identified six first-order factors with a total

of 30 items which are converged into the three major sub-trait (second-order) factors (Patton et al., 1995). Attentional Impulsiveness includes two first-order factors: attention (focusing on current tasks; i.e., I don't "pay attention.") and cognitive instability (intruding thoughts; i.e., I have "racing" thoughts). Motor Impulsiveness consists of two sub-factors: motor (acting quickly; i.e., I act "on impulse.") and perseverance (stable lifestyle; i.e., I change jobs). Non-planning Impulsiveness has two sub-factors: self-control (planning and thinking deliberatively; i.e., I plan tasks carefully.) and cognitive complexity (enjoyment of mental challenges; i.e., I like puzzles) (Patton et al., 1995).

Factor Structure of the BIS-11 and its Short Forms

Despite its popularity, there has been a lack of consensus on the factor structure of BIS-11 (e.g., Fossati, Barratt, Acquarini, & Di Ceglie, 2002; Ireland & Archer, 2008; Spinella, 2007). Barratt's three-factor structure was initially proposed from exploratory factor analyses (EFA) conducted by Patton and colleagues (1995). However, this factor structure has not been replicated by further studies, particularly in studies with confirmatory factor analysis (CFA). For instance, Someya and colleagues (2001) used CFA and showed that the Barratt's three-factor structure did not achieve satisfactory model fit (goodness-of-fit index [GFI] = .85, adjusted goodness-of-fit index [AGFI] = .82). Several studies have used EFA and identified alternative three-factor models, where the items that loaded on target factors differed from those in Patton and colleagues (e.g., Diemen, Szobot, Kessler, & Pechansky, 2007; Hartmann et al., 2011; Ireland & Archer, 2008).

The replicability of the six correlated first-order factors structure and its second-order structure proposed by Patton and colleagues (1995) has also been questioned (e.g., Reise et

al., 2013). Fossati and colleagues (2002) replicated the second-order structure based on six correlated first-order factors (comparative fit index [CFI] = .98, root-mean-square error of approximation [RMSEA] = .015) in an Italian adolescent sample. However, they found that the second-order factor 1 (attentional) was almost perfectly correlated with factor 2 (motor; r = .95, p < .001). Hence, Fossati and colleagues (2002) proposed a two second-order factors model (CFI = .99, RMSEA = .010).

To better capture the three-factor structure of the BIS proposed by Barratt, Spinella (2007) developed a short form of BIS-11. Spinella (2007) applied a principal component analysis with varimax rotation using an American community sample (N = 700) and identified the three factors consistent with Barratt's three-factor model. Five items with the highest loadings from each of the three established factors were chosen to form the short version of BIS (BIS-15). The total scores of the BIS-15 were highly correlated with those of the original version (r = .94; Spinella, 2007). The three-factor structure of the BIS-15 has been supported in several recent studies (Meule, Vögele, & Kübler, 2011; Orozco-Cabal et al., 2010).

More recently, Steinberg and colleagues (2013) developed a unidimensional scale of BIS in a sample of college student (N = 1,178; 77% female). Eight items (BIS-8) were selected from the original BIS-11 via the item response theory models. The BIS-8 has demonstrated promising psychometric properties in an American community sample and a clinical sample involving patients who had borderline personality disorder (Steinberg, Sharp, Stanford, & Tharp, 2013), as well as in a range of offender samples (Fields et al., 2015). Additionally, the BIS-8 scores showed positive associations with measures of aggression and personality

disorders (borderline, anti-social, and aggressive subscales).

The BIS in Chinese Populations

Several studies have applied and examined the factor structure of the BIS-11 in Chinese samples including a large and diverse community sample of adults (urban resident = 548, rural resident = 603, college student = 627; Li et al., 2011), a mixed adult sample (college student = 78, urban resident = 283; Zhou et al., 2006) and adolescents (Yao et al., 2007). Zhou and colleague's study (2006) found that the three second-order factors structure based on the six correlated first-order factors did not yield a satisfactory model fit (GFI = .81, AGFI = .77, RMSEA = .69). Similarly, Yao and colleague's study (2007) reported poor model fit for the three second-order factors structure (NNFI = .73, CFI = .78, RMSEA = .09), although this has been the best among a range of models. More recently, Huang and colleagues (2013) applied the BIS-11 in a sample of opioid-dependent male patients in northern Taiwan. Their EFA results revealed a three-factor model that was different from the original three-factor model proposed by Patton and colleagues (1995).

Overall, similar to the findings in Western samples, the factor structure of BIS-11 in Chinese samples remains unresolved. Moreover, previous studies with Chinese participants fell short in terms of sample limitations (i.e., only in community sample). Although impulsivity is a continuous personality trait, research using nonclinical population (except for Huang et al., 2013) is insufficient as the general population usually presents low to moderate impulsivity. Therefore, it is imperative that more in-depth validation studies are conducted in key samples, such as those in correctional/forensic settings, to better understand how impulsivity might be expressed in Chinese populations (Fields et al., 2015). Additionally,

despite these studies, no studies have validated the reliability and validity of the short forms of BIS-11 with Chinese samples, particularly in criminal samples.

The Present Study

Factor structures of a construct may hinge on the underlying psychological mechanisms or neural pathways (Barratt, 1994), and therefore understanding the construct and sub-constructs may benefit the development of interventions and therapies (e.g., different subconstructs may require different therapeutic strategies). Despite the abundance of research on the topic, there remains a lack of consensus regarding the underlying structure of impulsivity. Thus the primary aim of the current study was to examine the factor structure of the original, and two shortened versions, of the BIS in a sample of Chinese prisoners. Seven factor models that were previously discussed (Reise et al., 2013; Spinella, 2007; Steinberg et al., 2013) were tested and compared. Based on previous studies, we expected the BIS-8 to fit the data best. If so, consistent with the original study (Steinberg et al., 2013), the unidimensional model would be evaluated at the item level using IRT models. Secondly, we evaluated the construct validity of the optimal factor model by examining its associations with external criteria measures. More specifically, we expected that the BIS scores would be significantly and positively correlated with the ASPD self-report measures of aggression (i.e., Reactive-Proactive Aggression Questionnaire; Raine et al., 2006) and psychopathic traits (i.e., Youth Psychopathic Inventory-short version, YPI-S; van Baardewijk et al., 2010; Wang et al., 2017).

Method

Participants

The sample (N = 424) was collected from a moderate security level male prison in Guangdong province, south of China. The participants were aged from 18 to 52 years (M = 31.26, SD = 7.43), with 78 (18.4%) participants missing age information. The majority of the participants were of Han ethnicity (95.9%). The inmates were incarcerated for a variety of convictions, including property offenses (36%), drug-related crimes (35%), violent offenses (12%) and others (17%). About 48% (n = 206) of participants had never married, 32% (n = 137) were currently married, 9% (n = 39) were divorced, and 10% of participants failed to report. Twenty-three participants (5.4%) had only completed primary school (Year 6), 276 (65.1%) completed middle school (Year 9), 57 (13.4%) finished senior high school (Year 12), and 23 (5.4%) completed tertiary or above education, as well as 45 (11%) failing to report education information.

Measures

Barratt Impulsiveness Scale 11th version (BIS-11).

Each of the BIS-11 items was rated on a scale from 1 (*Rarely/never*) to 4 (*Almost always/always*). The three factors on item level of the BIS-11 are Attention (8 items), Motor (11 items), and Non-planning (11 items) (Patton et al., 1995). The BIS-11 was translated into Chinese and validated by Yao and colleagues (2007). Alpha coefficients for the BIS total and scale scores are presented in Table 1.

Short Version of Youth Psychopathic Inventory (YPI-S)

The YPI-S (van Baardewijk et al., 2010) includes 18 items selected from the original 50-item YPI (Andershed, Kerr, Stattin, & Levander, 2002), and each of the items is rated on a scale ranging from 1 (*Does not apply at all*) to 4 (*Applies very well*). The YPI-S has three

dimensions: Grandiose-Manipulative, Callous-Unemotional, and Impulsive-Irresponsible. Higher total scores reflect an increased level of psychopathic traits. Its factor structure, internal reliability, and convergent and criterion validity have been supported in Chinese adolescent (Wang et al., 2017) and young adult samples (Colins & Andershed, 2016; Neumann & Pardini, 2014). All participants (N = 424) completed the scale. Alpha coefficients for the total and factor scores for this study are presented in Table 1.

Antisocial Personality Disorder (ASPD)

The ASPD subscale of the Personality Diagnostic Questionnaire-4+ (PDQ-4+) was used to measure ASPD. The ASPD scale consists of 22 two-alternative forced-choice items that are rated as either true or false. The items correspond to the diagnostic criteria of ASPD from the Diagnostic and Statistical Manual of Mental Disorders (4th ed., American Psychiatric Association, 2000). The Chinese version of the PDQ-4+ has demonstrated low to acceptable internal consistency in college students (α = .56 - .78; Yang, Shen, Wang, & Yang, 2002) and test-retest reliability (α = .49 - .80). Four hundred and twenty (N = 420) participants finished the scale. The reliability estimate of the ASPD subscale for the current sample is displayed in Table 1, which indicates acceptable alpha and MIC values.

Reactive–Proactive Aggression Questionnaire (RPQ)

The RPQ (Raine et al., 2006) consists of 23 items, each of which are on a scale ranging from 0 (*Never*) to 2 (*Always*). Eleven items measured reactive aggression and 12 items measured proactive aggression. A previous study in a Chinese sample (11- to 15-year-old schoolchildren) demonstrated excellent internal consistency, good factorial validity, and construct validity of the RPQ (Fung, Raine, & Gao, 2009). A total of 416 participants finished

the Chinese version of RPQ in this study. Alpha coefficients for the total, reactive, and proactive aggression scores are shown in Table 1, and indicate good reliability.

Procedure

All participants provided informed written consent prior to participation. All questionnaires were administered in a study room in each block of the prison after a dinnertime period when the prisoners were in their own blocks. All participants were informed of the nature, purpose, and anonymity of the study. After completion, gifts valued at 10 YUAN (RMB; approximately 1.5 US dollar) were delivered to the participants. This study underwent review and protocol and was approved by the Human Subjects Review Committee at Guangzhou University.

Data Analysis

CFAs were conducted to examine the seven competing structures of the BIS using Mplus 7.4 (Muthén & Muthén, 2015). The seven competing models included: (M1) a single-factor model (30 items); (M2) a three correlated factors model (30 items); (M3) a six correlated factors model (30 items); (M4) two second-order factors model with six first-order factors model (30 items; Fossati et al, 2002); (M5) three second-order factors with six first-order factors model (30 items; Patton et al., 1995); (M6) three correlated factors model of the BIS-15 (15 items); and (M7) a single-factor model of BIS-8 (8 items). BIS items were treated as categorical and the robust weighted least-squares with mean and variance adjustment (WLSMV) estimator was used in the present study (Flora & Curran, 2004). Additionally, list-wise deletion was used to treat missing data when conducting CFA with WLSMV estimator (Muthén & Muthén, 2015). The commonly used fit indices were

employed (Hoyle, 2012; Kline, 2010; Muthén & Muthén, 2015): chi-square, RMSEA, Tucker-Lewis index (TLI), and CFI. The RMSEA values ≤ .08 indicate acceptable model fit and ≤ .05 indicate good model fit, and CFI, TLI ≥. 90 indicate adequate model fit (Kline, 2010).

Next, the Graded Response Model (Samejima, 1969) was used to evaluate the BIS-8 at item levels. The assumption of unidimensionality was tested by the one-factor CFA model, while the assumption of local independency was examined by the standardized local dependence (LD) chi-square statistics (based on the LD statistic proposed by Chen & Thissen, 1997). A slope parameter (i.e., the discrimination parameter) and three location parameters (i.e., the threshold parameters for a four-category response item) were estimated for each item. The slope parameter represents the slope of the curve and it is measured at the steepest point (the reflection point). It indicates how strongly the item is related to the measured trait—a larger slope value (a steeper slope) means that the item is related more to the trait and is discriminating more. The threshold parameter is the location of the inflection point of the item characteristic curve (ICC) on the trait scale. Finally, convergent validity of the optimal BIS model was evaluated by examining its correlations with psychopathic traits, ASPD, and aggression. To determine whether the strength of the correlations with criterion measures differed between the BIS-8 and the BIS-11/BIS-15, the method proposed by Dunn and Clark (1969) was used (see Steiger, 1980 for more details)[i].

Finally, to evaluate the internal consistency of the BIS scores, αs were calculated and interpreted as follows: < .60 = insufficient; .60 to .69 = marginal; .70 to .79 = acceptable; .80 to .89 = good; and .90 or higher = excellent (Barker, Pistran, & Elliot, 1994). The mean

inter-item correlation (MIC), a more straightforward indicator of a scale's internal consistency than α, was also used. MIC values within the range of .15 to .50 suggest that the internal consistency is adequate (Clark & Watson, 1995).

Results

Descriptive statistics

The means and standard deviations for all measures are showed in Table 1. Specifically, the mean score of the BIS-30 total was 67.18 (*SD* = 9.73), higher than that of community adults (*M* = 59.18, *SD* = 9.54; Reise et al., 2013). The average score of the BIS-8 was 16.78 (*SD* = 3.64), similar to that of U.S. forensic samples (*M* = 18.76, *SD* = 4.2; Fields et al, 2015).

CFA Results

Model fit indices for the seven models of the BIS are displayed in Table 2. For all models, the three-factor model of the BIS-15 showed marginal model fit indices (CFI = .91, TLI = .89, RMSEA = .10). We adopt modification index (MI) based on the suggestions of Kaplan and Wenger (1993) and MacCallum and colleagues (1992) to revise the models. In each modification iteration step, only one parameter was modified. We found that allowing for a correlation between two items' residuals (item 1, I "squirm" at plays or lectures; and item 2, I am restless at the theater or lectures) significantly improved the model fit. The two items have very similar contents. We thus endorsed the modification and obtained a new model (M8, CFI = .93, TLI = .92, RMSEA = .09). This model fit was significantly better than the model fit of model 6($\Delta\chi^2$ (1) = 74.67, $p < .001$).

The model fit for the unidimensional factor of the BIS-8 was acceptable with CFI = .93, TLI = .91, but has a slightly high RMSEA (.14). We found two items, 13 (I am a careful

thinker) and 14 (I plan tasks carefully), had high residual correlations. Allowing the residuals' correlation for these two items resulted in a revised model (M9), which had substantial better fit than the original model (M9; CFI = .96, TLI = .94, $\Delta\chi^2$ (1) = 62.52, $p < .001$). Further modifications could not improve the RMSEA, so we accepted the revised model (M9) with one paired errors as the final model. See Table 3 for the factor loadings.

IRT Results

The unidimensionality of the BIS-8 has been demonstrated by satisfactory model fit of the one-factor CFA results in the previous section. The standard LD statistics indicate that there was no pair of items that had substantial residual correlations that may raise concern. A GRM was run on the BIS-8 data and Table 3 displays the results including the slope (*a*) and location parameters (b_1, b_2, and b_3). The slope parameters for items of BIS-8 ranged from 1.28 (I concentrated easily) to 2.22 (I do things without thinking), indicating strong associations between the eight items and the latent trait. The values of the three location parameters (b_1, b_2, and b_3) were very similar for all items. Parameter b_1 is moderate and negative (ranging from -2.87 to -2.03) for all items, parameter b_2 is positive (ranging from .77 to 2.78) for all items, and b_3 is positive (ranging from 3.57 to 6.06). This indicates that only prisoners with high levels of impulsivity (i.e., positive end of the latent trait) were likely to engage in options 2 to 4 on the scale.

The test information curve and standard error of measurement are displayed in Figure 1. The test information curve is similar to the previous study using the English-speaking sample (Steinberg et al., 2013). The test information was relatively higher than the standard error of measurement (SEM) for the latent trait level ranging from -1 to 4, indicating the BIS-8 was

more informative and precise when measuring the positive end of the latent trait.

Internal Consistency

Internal consistency for total and factor scores of the BIS-11, BIS-15, and BIS-8 are displayed in Table 1. Internal consistencies measured by Cronbach's alpha for all BIS scores were generally acceptable (with an exception for the Attentional factor), ranging from .68 (BIS-11, Attentional) to .87 (BIS-11, total score). All MIC values were in an acceptable range. The internal consistency estimate for BIS-8 was $\alpha = .82$ (MIC = .37). The BIS-8 was highly correlated with BIS-11 and BIS-15, *rs* = .91 and .94 (*p*s < .001), respectively.

Convergent Validity

Zero-order correlations between total scores of BIS-11, BIS-15, and BIS-8 and the external criteria measures are displayed in Table 4. The majority of the associations for the BIS-8 were highly similar to those of the original 30-item scale and the 15-item scale. This is not surprising given the very high correlation (*rs* > .90) between the BIS-8 and the BIS-11/BIS-15.

More specifically, impulsivity was strongly correlated with the YPI-S Impulsive-Irresponsible ($r = .70$, $p < .001$) and YPI-S total ($r = .57$, $p < .001$), and moderately correlated with ASPD, RPQ total and its two factors scores, and the YPI-S Callousness-Unemotional score (*rs* = .34 - .46, *p*s < .001). Additionally, a small but significant positive association was found between Impulsivity and YPI-S Grandiose-Manipulative dimension ($r = .20$, $p < .001$).

To examine whether the long versus short forms of the BIS have correlations with the external criterion in similar magnitude, *Z* values ($p < .001$, 2-tailed for significance) were

calculated on the basis of Dunn and Clark's (1969) method (see Table 4). The majority of the correlations in magnitude for the 30-item BIS as well as the 15-item BIS versus the 8-item scores were non-significant ($Z < 2.58$) with external variables.

Discussion

The current study aimed to examine the factor structure and psychometric properties of the BIS original and short forms in a sample of Chinese prisoners. Seven factor models proposed in the literature were tested and compared. Specifically, the three correlated factors model of the BIS-15 and a unidimensional structure of the BIS-8 showed a relatively satisfactory model fit, good internal consistency, and expected convergent validity.

Consistent with most previous studies (e.g., Fossati et al., 2002; Hartmann et al., 2011; Reise et al., 2013), our results did not support any factor models based on the original BIS-11 (30 items). On the other hand, both the three correlated factors model of the BIS-15 (15 items) and the single-factor model of the BIS-8 (8 items) had substantially better fit than the BIS-11 models. As noted by Steinberg and colleagues (Steinberg et al., 2013), many instruments that were developed in the 1960s and 1970s are quite lengthy. Items that are redundant and seem unrelated to the theme of the construct were added to improve the scale reliability, commonly measured by alpha coefficients. On the other hand, similar to previous findings (Meule et al., 2011; Orozco-Cabal et al., 2010; Spinella, 2007), the BIS-15 achieved acceptable fit indices and was highly correlated with BIS-11. This implies that more than a half of the original BIS-11 items might be superfluous (BIS-15 only retained five items of each subscale of BIS-11 with the highest factor loadings).

It is worth noting that, in the present sample, the residuals of two items (I "squirm" at

plays or lectures and I am restless at the theater or lectures) of the BIS-15 were allowed to be correlated to improve the model fit. The two items share a substantial amount of unique variance due to the high similarity in their contents. This result demonstrates that redundant item contents could deteriorate model fit. Similarly, the single-factor model of the BIS-8 also had two items that had highly correlated error variance.

The single-factor model of the BIS-8 fitted the data best, which is consistent with several recent studies (Fields et al., 2015; Steinberg et al., 2013). Moreover, the IRT analyses revealed encouraging item properties of the BIS-8. The slope parameters of each item for BIS-8 were above 1.2, indicating adequate contributions of items to the total information. The location parameters increases monotonically, suggesting reasonable grades of scoring. Altogether, the results regarding the latent structure of impulsivity indexed by BIS-15 and BIS-8 indicated that the current Chinese sample shared similar manifest behavior with the previous Western samples from previous research.

Impulsivity has been defined as multicomponent construct (e.g., Patton et al., 1995; Stanford et al., 2009); however, Steinberg and colleagues (2013) failed to replicate the three-factor structure of the BIS through a confirmatory multidimensional IRT approach, and then developed a short-form scale with 8 items to assess general impulsivity (i.e., BIS-8). However, the BIS-8 is limited in terms of its utility in the investigation of the more specific components of impulsiveness (e.g., motor or non-planning). For example, some studies found the subscales of BIS presented different correlations with criteria measures (e.g., Swann et al., 2008). More specifically, in a clinical sample, Swann and colleagues reported the Attentional subscale scores significantly correlated with anhedonia ($r = .221$, $p < .01$) and hopelessness (r

= .238, $p < .01$), but not the Motor subscale scores ($r = -.026$ and .146, $ps > .05$, respectively). In the present study, the pattern of correlations of BIS-15 with the criteria measures was generally consistent and comparable with previous findings, indicating that the BIS-15 retained enough information from the BIS-11. Thus, the BIS-15 and BIS-8 together may be promising alternatives to the BIS-11 for researchers to investigate specific components of impulsivity and general impulsivity, respectively.

Finally, consistent with previous studies (e.g., Feilhauer & Cima, 2013; Pechorro, Ayala-Nunes, Ray, Nunes, & Gonçalves, 2016), the scores of BIS-11, BIS-15 and BIS-8 had strong correlations with measures of aggression. Moreover, impulsivity strongly correlated with ASPD (e.g., Fossati et al., 2004; McCown, Johnson, & Shure, 1993), as well as YPI-S total and factor scores, especially the YPI-S Impulsive-Irresponsible dimension (Hare, 2003). Impulsivity has been an important criterion in a wide range of psychiatric disorders. Therefore, the sound psychometric properties of the BIS-15 and BIS-8 suggest the two could be useful in clinical assessment settings as well as in epidemiological studies of psychiatric disorders.

The current findings have important implications for both practical and research settings. First, the results supported the three-factor model of the BIS-15 and the single factor model for the BIS-8. Researchers who are interested in specific components of impulsiveness may use the BIS-15 (e.g., therapeutic interventions), while those who aim to assess general impulsivity (e.g., risk screening) may use the BIS-8. Additionally, both the single factor model and three-factor model fit the data well, suggesting that impulsivity can be defined at different levels of abstraction. At the top level, impulsivity can be measured directly as a

unidimensional construct (i.e., BIS-8), meanwhile, at the subordinate level, the different facets of impulsivity can be measured (i.e., BIS-15). In this, the different levels, or models, through which we can understand impulsivity resembles how we understand general models of personality. For example, the big five personality model can not only be measured with a hierarchical structure (low order trait), but can also be assessed as a higher-order dimension (e.g., NEO-PI-R vs. NEO-FFI).

Some limitations of the current work should be acknowledged. First, the findings of the current study were obtain from male prisoners: whether the findings can be generalized to female prisoners and other populations (e.g., community adult and adolescent samples) requires further validation. The second limitation was the reliance on self-report measures for the convergent validity analyses. Such methodology introduces shared method variance, which can inflate the magnitude of observed correlations. Future investigations would benefit from using laboratory behavioral tasks (Sharma, Markon, & Clark, 2014). Finally, the external criteria measures used in the present study were limited to psychopathic traits and aggression. Future research could include other significant behavioral variables, such as substance use, gambling, and dangerous driving (Sharma, Markon & Clark, 2014).

In conclusion, the present study provides new support for the factor structure and psychometric properties of the two shortened versions of the Barratt Impulsiveness Scale in Chinese prisoners. Our findings suggest that the performance of the 8-item BIS was comparable to that of the original 30-item BIS scale in measuring general impulsivity, and the three-factor model of the BIS-15 could appropriately cover the original theoretical proposal. Therefore, in future research, particularly in Chinese samples, research focusing on specific

components of impulsiveness could choose the BIS-15, while for studies that seek to assess general impulsivity, the BIS-8 is the best choice.

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[i] The statistics were calculated by means of a spreadsheet that was developed by DeCoster and Lselin (2005) and can be retrieved at: http://stat-help.com/spreadsheets.html

Table 1

Descriptive Statistics and Internal Consistencies for All Variables Measured

	Alpha	MIC	M	S.D.	N of Items	*N*
BIS-11						
Total score	.87	.18	67.18	9.73	30	377
Attentional	.68	.21	17.68	3.14	8	408
Motor	.75	.21	24.36	4.33	11	407
Non-planning	.76	.24	25.18	4.21	11	407
BIS 15						
Total score	.86	.30	32.37	6.22	15	406
Attentional	.71	.33	10.53	2.37	5	418
Motor	.79	.43	10.59	2.73	5	417
Non-planning	.75	.38	11.28	2.45	5	418
BIS 8						
General Impulsivity	.82	.37	16.78	3.64	8	409
Criterion variables						
YPI-S						
Total score	.81	.20	36.66	7.26	18	392
Grandiose-Manipulative	.71	.29	11.48	2.99	6	411
Callous-Unemotional	.62	.22	12.67	3.10	6	414
Impulsive-Irresponsible	.73	.32	12.62	3.29	6	413
ASPD	.85	.20	6.71	4.69	22	409
RPQ						
Total score	.92	.33	11.04	7.30	23	398
Reactive Aggression	.83	.30	7.05	3.62	11	411
Proactive Aggression	.89	.41	3.98	4.26	12	403

Notes. MIC = mean inter-item correlation. BIS-11 = Barratt Impulsiveness Scale, version 11; BIS 15 = the short version with 15 items of the BIS; BIS 8 = the short version with 8 items of the BIS, YPI-S = short version of Youth Psychopathic Inventory; ASPD = antisocial personality disorder; RPQ = Reactive–Proactive Aggression Questionnaire.

Table 2

Model Fit Indices for the Nine Competing Models of BIS

	Model	*WLSMVχ^2*	*df*	*CFI*	*TLI*	*RMSEA*	*90% CI*
M1	Unidimensional factor of BIS-11	1677.54**	405	.81	.79	.09	[.08 .09]
M2	Three correlated factors of BIS-11	1509.23**	402	.83	.82	.08	[.08 .09]
M3	Six correlated factors of BIS-11	1411.10**	390	.84	.83	.08	[.07 .08]
M4	Fossati second-order model of BIS-11	1439.89**	398	.84	.83	.08	[.07 .08]
M5	Patton second-order model of BIS-11	1435.72**	396	.84	.83	.08	[.07 .08]
M6	Three correlated factors of the BIS 15	478.81**	87	.91	.89	.10	[.09 .11]
M7	Unidimensional factor of BIS 8	180.92**	20	.93	.91	.14	[.12 .16]
M8	Revised M6(allow residuals of items 1 and 2 to correlate)	377.23**	86	.93	.92	.09	[.08 .10]
M9	Revised M7(allow residuals of items 13 and 14 to correlate)	113.41**	19	.96	.94	.11	[.09 .13]

Notes. **$p < .001$. WLSMVχ^2 = Chi-square of the robust weighted least-squares with mean and variance adjustment estimator; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root-mean-square error of approximation; CI = confidence interval.

Table 3

Standardized Factor Loadings, Slope and Threshold Parameters for the Single-Factor Model of BIS 8

	Loading	*a*	b_1	b_2	b_3
I plan tasks carefully. (*r*)	.65(.03)	1.52(.22)	-2.73(.25)	1.43(.17)	5.26(.47)
I do things without thinking.	.79(.03)	2.22(.25)	-2.06(.26)	2.78(.31)	6.06(.67)
I don't "pay attention".	.66(.03)	1.50(.17)	-2.19(.20)	1.69(.18)	4.68(.41)
I am self-controlled. (*r*)	.66(.03)	1.56(.17)	-2.33(.21)	2.15(.20)	4.87(.39)
I concentrated easily. (*r*)	.57(.04)	1.28(.18)	-2.48(.21)	1.45(.16)	4.38(.42)
I am a careful thinker. (*r*)	.76(.02)	1.95(.28)	-2.87(.28)	1.50(.20)	5.74(.51)
I say things without thinking.	.73(.03)	1.87 (.20)	-2.03(.22)	2.40(.25)	5.57(.52)
I act on the spur of the moment.	.60(.03)	1.34(.17)	-2.43(.20)	.77(.14)	3.57(.29)

Notes. *r* = reversed coded items. *a* = slope parameter, *b* = threshold parameter. Standard errors are in parentheses.

Table 4

Zero-order correlations between external criteria and the total scores of BIS-11, BIS 15, and BIS 8

	r			*Z* (BIS 8 vs BIS-11)	*Z* (BIS 8 vs BIS 15)
	BIS-11	BIS 15	BIS 8		
YPI-S					
Total score	.61**	.58**	.57**	2.43	.60
Grandiose-Manipulative	.26**	.21**	.20**	2.99*	.50
Callous-Unemotional	.38**	.35**	.34**	2.08	.52
Impulsive-Irresponsible	.73**	.72**	.70**	2.13	1.41
ASPD	.43**	.42**	.35**	4.24**	3.70**
RPQ					
Total score	.51**	.49**	.46**	2.79*	1.66
Reactive Aggression	.48**	.44**	.41**	3.82**	1.61
Proactive Aggression	.45**	.45**	.42**	1.62	1.62

Notes. * $p < .01$, ** $p < .001$. Z was calculated on the basis of the method proposed by Dunn and Clark (1969). BIS-11 = Barratt Impulsiveness Scale, version 11; BIS 15 = the short version with 15 items of the BIS; BIS 8 = the short version with 8 items of the BIS, YPI-S = short version of Youth Psychopathic Inventory; ASPD = antisocial personality disorder; RPQ = Reactive–Proactive Aggression Questionnaire.

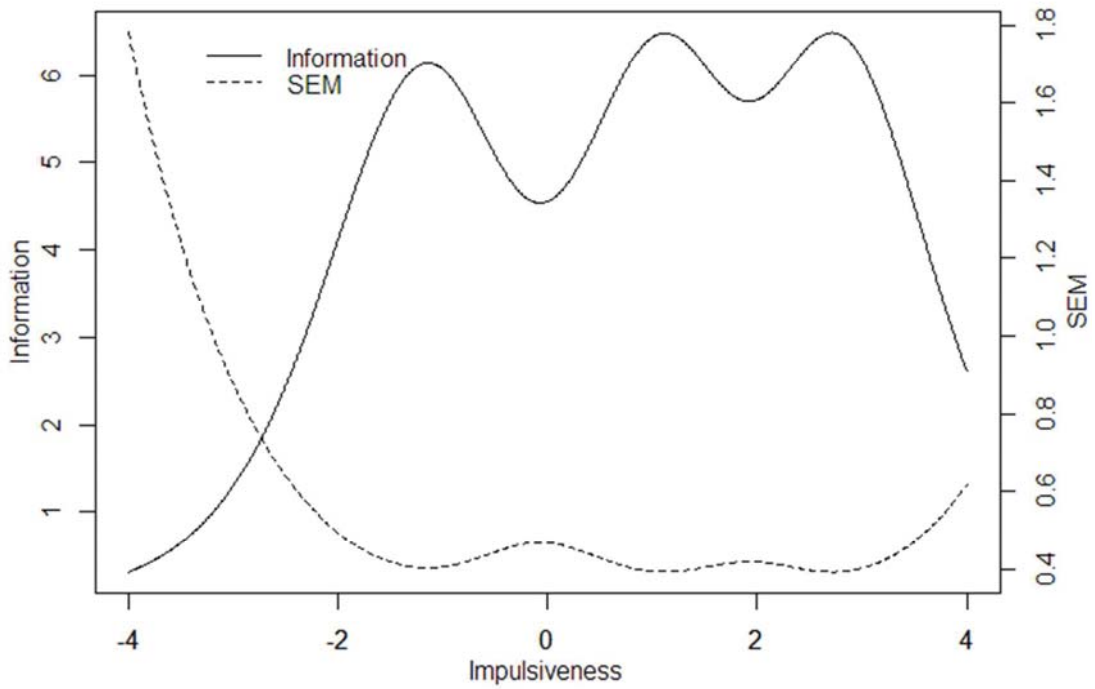

Figure 1. Test information curve for the BIS 8 showing how well the construct is measured at all levels of the underlying construct continuum.